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## Investigating the Impact of Demographic Variables and Body Mass Index in Irritable Bowel Syndrome Patients

Shraddha Saroj<sup>1</sup>, Kalpna Gupta<sup>2</sup>, Sumit Rungta<sup>3</sup>, Anil Gangwar<sup>4</sup>,  
Narendra Kumar<sup>5</sup> and Devanand Bharti<sup>6</sup>

### ABSTRACT

**Background:** Irritable bowel syndrome (IBS) is a chronic gastrointestinal disorder affecting the lower gastrointestinal tract. **Objectives:** This study aims to analyse the effect of demographic variables such as sex, age and relationship status along with anthropometric variable such as body mass index (BMI) on IBS patients. **Methods:** This is a prospective observational study in which 245 IBS patients were enrolled using Rome IV criteria from 16<sup>th</sup> July, 2022 to 15<sup>th</sup> July, 2023. Informed consent was taken from all the patients and they were classified based on the stool pattern. IBM-SPSS Version 20 was used for data analysis. **Results:** In this study the males 161 (65.7%) outnumbered females 84 (34.3%) by almost 2:1 ratio. The mean age of IBS patients was 34.25±11.30 years. Overall, there were 46.1% constipation predominant, 24.5% diarrhoea predominant, 15.5% mixed type and 13.9% unsubtyped IBS patients. In Central North Indian region youngsters (107, 43.7%) are more prone to irritable bowel syndrome and as the age increases the number of IBS patients showed a reduction [ $\chi^2$  (3, 245) = 56.176; p<0.001]. Although positive associations were observed, there were no significant correlations reported between sex, age group, relationship status and body mass index with reference to different sub-types of IBS. **Conclusion:** The study concludes that majority of IBS patients were constipation predominant young males who were married and had normal BMI. Although no significant association was found within the sub-types of IBS, a more comprehensive study with a larger sample size will be more beneficial for generalization of results.

**Keywords:** Irritable Bowel Syndrome, India, Sex, Age Groups, Body Mass Index.

### Introduction

Irritable bowel syndrome (IBS) is a chronic gastrointestinal disorder affecting the lower gastrointestinal tract<sup>1</sup>. It's a functional gastrointestinal disorder (FGIDs) characterized by unexplained abdominal pain associated with changes in bowel habits<sup>2</sup>. Although the major cause of IBS remains unknown several mechanisms have been formulated for its diagnosis.

Present study was conducted using the latest Rome IV criteria for diagnosis of irritable bowel syndrome patients. Based on the stool pattern the IBS patients are classified as: constipation pre-dominant IBS patients (IBS-C), diarrhoea pre-dominant IBS patients (IBS-D), mixed-type IBS patients (showing symptoms of IBS-C and IBS-D) and unsubtyped IBS representing no specific stool pattern<sup>2</sup>.

1. Research Scholar (SRF), Food Science and Nutrition, Department of Home Science, Banaras Hindu University, Varanasi, **Email-** shradz26@bhu.ac.in, Contact: 9653058900.
2. Professor, Human Development, Department of Home Science, BHU, **Email-** kgupta.bhu@gmail.com, Contact: 9651728767.
3. Associate Professor, Department of Gastroenterology (Head), King George Medical University, Lucknow, Uttar Pradesh, India. **Email-** drsumitrunta79@gmail.com, Contact: 9935537944.
4. Consultant, Department of Gastroenterology, Vivekanand Polyclinic and Institute of Medical Sciences, Lucknow, **Email-** anilgangwargsvm0@gmail.com, Contact: 9453919738.
5. Associate Professor, Department of Trauma Surgery, King George Medical University, Lucknow, Uttar Pradesh, India. **Email-** drnarenkgmu@gmail.com, Contact: 8317055276.
6. Senior Resident, Department of Ophthalmology, King George Medical University Lucknow, Uttar Pradesh, India. **Email-** bhartidevanand41@gmail.com, Contact: 7007051747.

**Corresponding Author:** Shraddha Saroj, Research Scholar (Senior Research Fellow), Food Science and Nutrition, Dept. of Home Science, BHU, Varanasi, **Email Id:** shradz26@bhu.ac.in; **Mob. +91 9653058900; ORCID:** <https://orcid.org/0000-0003-4648-4904>

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**Aim:** The study aims to analyse the effect of demographic variables such as gender, age and relationship status along with anthropometric variable such as body mass index (BMI) on different types of irritable bowel syndrome patients.

**Significance of the study:** Detailed study about the association of demographic variables with different types of irritable bowel syndrome will help in developing individualized approach for the management of IBS. Identifying specific group of IBS patients that are prone to particular IBS-type will help in better management of symptoms and development of strategies for future. Moreover, studying IBS in relation to body mass index will help in managing double burden i.e., symptoms of irritable bowel syndrome and malnutrition such as under-nutrition and over-nutrition. This may also open new routes to study IBS in the light of metabolic pathways and inflammatory factors involved<sup>3</sup>.

### Objectives of the Study

- To study the effect of gender on different sub-types of irritable bowel syndrome.
- To analyze the role of age group on the stool pattern of irritable bowel syndrome patients.
- To assess the impact of relationship status on various IBS-sub types.
- To determine the significance of body mass index (BMI) on different sub-types of IBS.

### Methodology

The research paper was written following strobe guidelines.

**Study Design:** Prospective Observational Study

**Sample Size:** 245 irritable bowel syndrome patients

**Area:** Primary data was collected from the Gastroenterology OPD of Tertiary Healthcare Centre, Uttar Pradesh.

**Ethical consideration:** The IBS patients were informed about the research. They were provided with all the information about the research objectives, purpose of the study, potential contribution in research and maintenance of confidentiality. All the patients signed the consent form to voluntarily participate in the study. Ethical clearance for the study was taken from the ethics committee of the Institute.

**Diagnosis:** IBS patients were recruited based on Rome IV criteria by the medical practitioner.

**Tools and techniques:** Standardized interview schedule was used to collect all the information from the IBS patients.

**Statistical Analysis:** Data was coded and stored in Microsoft-excel. Further IBM SPSS Statistics Version 20 was used for the analysis of data. The graphs and charts were prepared in Microsoft-excel. Descriptive analysis such as frequency distribution, percentile, mean, median, mode, range and standard deviation are used. Cross-tabulation was used to find association between different variables. Inferential analysis was carried out using chi-square goodness of fit test (in case of one variable) and chi-square test of independence (2 or more variable). Independent sample t-test was used to compare the mean age of male and female patients. 95% confidence interval was used and probability value of less than 0.05% was considered significant.

### Results

A total of 24,000 patients who visited the Gastroenterology OPD were assessed for 1 year (365 days) out of which 350 participants were identified as IBS patients. Thus, the reported prevalence in this study was 1.45%. In this research article 245 IBS patients who voluntarily participated till the end of the study are included, among the remaining 120, 36 left the interview schedule incomplete and 84 patients were lost during follow up.

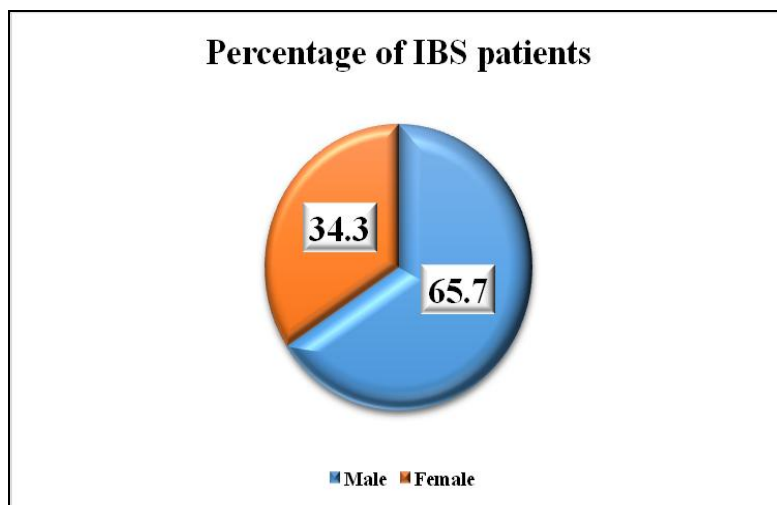
Table 1 show that the mean age of the IBS patients was  $34.25 \pm 11.30$  years, with a minimum age of 18 and maximum age of 66 years respectively. Additionally, the table represents that the skewness for age is 0.627 which points

to the fact that the data is positively skewed and that further indicates that more values lie towards right tail of the normal probability curve (NPC). As, skewness lies between  $\pm 1$  range of the normal distribution, this suffices the use of parametric tests for further analysis. Similar trend can be observed for other variables like weight, height and BMI.

**Table- 1:** Descriptive statistics for demographic variables i.e., Age, Weight, Height and BMI.

		Age (yrs)	Weight (kg)	Height (cm)	BMI
N	Valid	245	245	245	245
	Missing	0	0	0	0
Mean		34.25	58.85	162.12	22.44
Median		32.00	58.00	163.00	22.00
Mode		23	50	165	22.00
Std. Deviation		11.304	10.278	9.115	3.702
Variance		127.778	105.637	83.083	13.705
Skewness		0.627	0.352	-0.381	0.152
Std. Error of Skewness		0.156	0.156	0.156	0.156
Kurtosis		-0.449	-0.016	0.085	-0.221
Std. Error of Kurtosis		0.310	0.310	0.310	0.310
Minimum		18	38	132	14.00
Maximum		66	93	182	33.00
Percentiles	25	24.50	51.00	155.50	20.00
	50	32.00	58.00	163.00	22.00
	75	43.00	65.00	168.00	25.00

**Fig.- 1:** Pie chart showing percentage distribution of IBS patients according to their gender

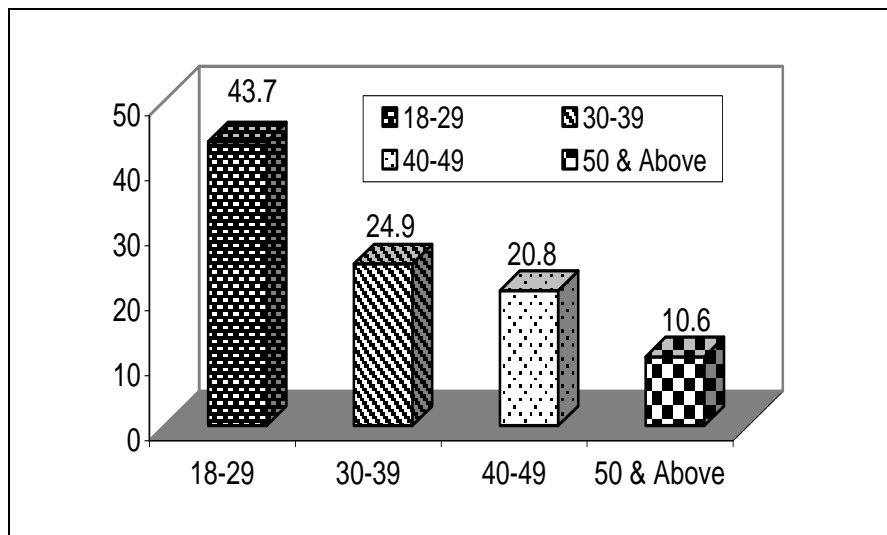


**Table -2:** Independent samples t-test to compare the mean age of male and female

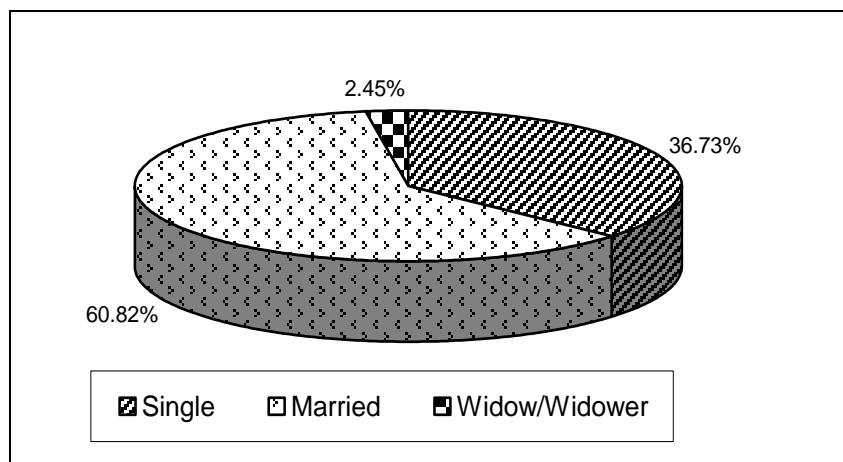
Independent Samples t-Test (2-tailed)											
Gender	No.	Mean ± SD	f-value	Sig	t-value	df	p-value	Mean difference	Std. Error diff.	95% Confidence Interval of the Difference	
Male	161	33.50±11.17	0.26	0.60	-1.44	243	0.15	-2.19	1.51	Lower	Upper
Female	84	35.69±11.48								-5.18	.79

\*p<0.05 (statistically significant); df: degrees of freedom

**Fig.-1:** IBS patients in different age groups



**Fig.- 2:** Percentage of IBS patients in different age groups represented using Funnel Chart



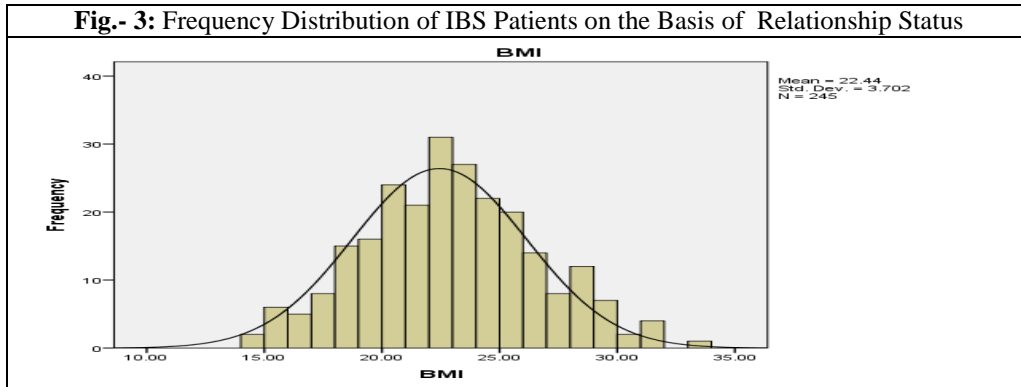


Fig 4: Classification of the Irritable Bowel Syndrome patients on the basis of stool pattern.

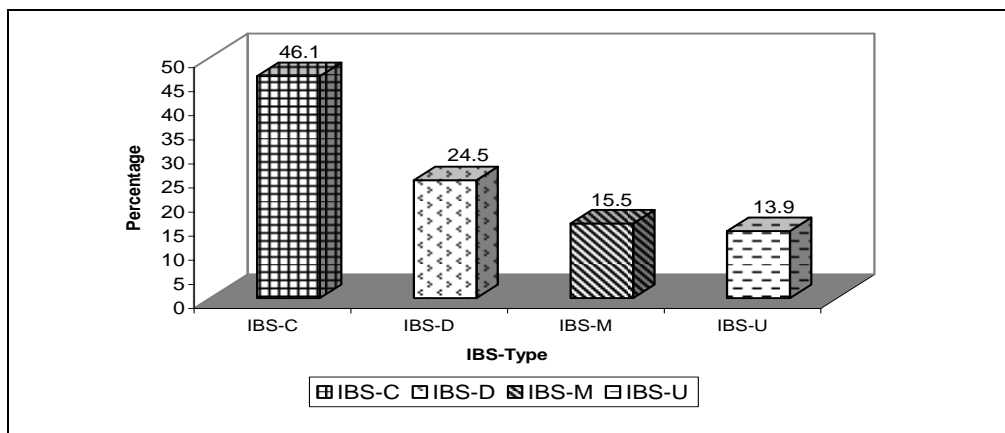


Figure 4 shows the classification of IBS patients on the basis of their stool pattern as constipation predominant (IBS-C), diarrhoea pre-dominant (IBS-D), mixed-subtyped (IBS-M) and unsubtyped (IBS-U). The decrease in the number of IBS patients with 113 (46.1%) maximum number of constipation pre-dominant IBS patients and 34 (13.9%) minimum number of unsubtyped IBS patients (Fig.-5).

Table -3: Showing relation between Gender and IBS-Type

			IBS Type (Stool Pattern)				Total
			IBS-C	IBS-D	IBS-M	IBS-U	
Gender	Male	Frequency	73	39	25	24	161
		P1	45.3%	24.2%	15.5%	14.9%	100%
		P2	64.6%	65.0%	65.8%	70.6%	65.7%
	Female	Frequency	40	21	13	10	84
		P1	47.6%	25.0%	15.5%	11.9%	100%
Total		Frequency	113	60	38	34	245
		P1	46.1%	24.5%	15.5%	13.9%	100%
		P2	100%	100%	100%	100%	100%

Note:

- i.  $\chi^2(3, 245) = 0.434; p = 0.933$
- ii. P1: refers to percentage within gender (rows)
- iii. P2: refers to percentage within IBS-Type (column)

**Table -4:** Showing association between Age Groups and IBS-Type

		IBS-Type (Stool Pattern)				Total	
		IBS-C	IBS-D	IBS-M	IBS-U		
Age Group (yrs)	18-29	Frequency	49	25	16	17	107
		P1	45.8%	23.4%	15.0%	15.9%	100%
		P2	43.4%	41.7%	42.1%	50.0%	43.7%
	30-39	Frequency	30	17	9	5	61
		P1	49.2%	27.9%	14.8%	8.2%	100%
		P2	26.5%	28.3%	23.7%	14.7%	24.9%
	40-49	Frequency	24	12	7	8	51
		P1	47.1%	23.5%	13.7%	15.7%	100%
		P2	21.2%	20.0%	18.4%	23.5%	20.8%
	50 and above	Frequency	10	6	6	4	26
		P1	38.5%	23.1%	23.1%	15.4%	100%
		P2	8.8%	10.0%	15.8%	11.8%	10.6%
Total	Frequency	113	60	38	34	245	
	P1	46.1%	24.5%	15.5%	13.5%	100%	
	P2	100%	100%	100%	100%	100%	

**Note:**

- i.  $\chi^2 (9, 245) = 3.848; p = 0.921$
- ii. P1: refers to percentage within age group (rows)
- iii. P2: refers to percentage within IBS-Type (column)

**Table- 5:** Showing association between Relationship Status and IBS-Type

		IBS-Type (Stool Pattern)				Total	
		IBS-C	IBS-D	IBS-M	IBS-U		
Relationship Status	Single	Frequency	43	22	14	11	90
		P1	47.8%	24.4%	15.6%	12.2%	100%
		P2	38.1%	36.7%	36.8%	32.4%	36.7%
	Married	Frequency	68	36	22	23	149
		P1	45.6%	24.2%	14.8%	15.4%	100%
		P2	60.2%	60.0%	57.9%	67.6%	60.8%
	Widow/ Widower	Frequency	2	2	2	0	6
		P1	33.3%	33.3%	33.3%	0.0%	100%
		P2	1.8%	3.3%	5.3%	0.0%	2.4%
Total	Frequency	113	60	38	34	245	
	P1	46.1%	24.5%	15.5%	13.5%	100%	
	P2	100%	100%	100%	100%	100%	

**Note:**

- i.  $\chi^2 (6, 245) = 3.026; p = 0.806$
- ii. P1: refers to percentage within age group (rows)
- iii. P2: refers to percentage within IBS-Type (column)

**Table- 6:** Showing association between Body Mass Index and IBS-Type

		IBS-Type (Stool Pattern)				Total	
		Constipation	Diarrhoea	Mixed	Undefined		
BMI (Body - Mass Index)	Underweight	Frequency	13	8	8	7	36
		P1	36.1%	22.2%	22.2%	19.4%	100%
		P2	11.5%	13.3%	21.1%	20.6%	14.7%
	Normal	Frequency	63	38	15	21	137
		P1	46.0%	27.7%	10.9%	15.3%	100%
		P2	55.8%	63.3%	39.5%	61.8%	55.9%
	Overweight	Frequency	4	4	4	1	13
		P1	30.8%	30.8%	30.8%	7.7%	100%
		P2	3.5%	6.7%	10.5%	2.9%	5.3%
	Pre-obese	Frequency	29	10	10	5	54
		P1	53.7%	18.5%	18.5%	9.3%	100%
		P2	25.7%	16.7%	26.3%	14.7%	22.0%
	Obese	Frequency	4	0	1	0	5
		P1	80.0%	0.0%	20.0%	0.0%	100%
		P2	3.5%	0.0%	2.6%	0.0%	2.0%
	Total	Frequency	113	60	38	34	245
		P1	46.1%	24.5%	15.5%	13.9%	100%
		P2	100%	100%	100%	100%	100%

**Note:**

- i.  $\chi^2 (12, 245) = 14.359; p = 0.278$
- ii. P1: refers to percentage within age group (rows)
- iii. P2: refers to percentage within IBS-Type (column)

**Discussion**

The present study was done with an aim to understand the impact of demographic variables such as sex, age group and relationship status along with BMI on different types of irritable bowel syndrome based on Rome IV criteria. The reported prevalence in this study was 1.45% according to Rome IV criteria which falls in the range of 0.4 to 4.2% as reported by Indian consensus statement on Irritable Bowel Syndrome, 2023.<sup>4</sup> Figure 1 shows that majority of the IBS patients visiting the hospital were males (161, 65.7%) and only 84, 34.3% were females which is contrasting to the prevalence of IBS as reported by many studies<sup>5</sup>. The probability value ( $p < 0.001$ ) of less than 0.05 indicates that there is a significant difference between the observed and the expected values. Western countries have reported 2-3 times higher prevalence of IBS among females compared to males<sup>6</sup>. A study conducted in rural Indian community involving door-to-door survey also reported a high prevalence of IBS among females<sup>7</sup>. However, another multicentric Indian study reported high number of male IBS patients<sup>8</sup>. This clearly explains the difference observed in a hospital-based study and community-based settings (Fig- 1). Interestingly, a Korean study have reported that IBS is twice as common in females as compared to males<sup>5,9</sup>. High number of male patients [ $\chi^2 (2, 245) 24.20; p < 0.001$ ] in a hospital-based study indicates more awareness among males towards their health. Moreover, as India is a male dominant society, gender disparity makes it difficult for women to visit hospitals unless there is a serious health problem<sup>7</sup>. Another reason can be the trust on other health care delivery systems such as Ayurveda, Homeopathy etc. compared to Allopathy which is more common among females as compared to males<sup>10</sup>. In addition to this, it is well-known that IBS is not life-threatening<sup>11</sup> so Indian females prefer home remedies over visiting a health care provider for a number of health issues.

An assumption for performing independent sample t-test is that both the groups have equal variances. The null hypothesis states that there is no significant difference between the variance of the two groups i.e., male and female which was tested using Levene's test and it revealed that the significance value is 0.609 which is higher than 0.05 thus inferring that there is no significant difference in the variance of male and female gender. Hence, the null hypothesis is accepted.

The above table also shows that according to independent sample t-test,  $t(245) = -1.44$ ,  $p = 0.15$  which is  $p > 0.05$ . Thus, there is no significant difference between the mean age of males ( $33.50 \pm 11.17$ ) and females ( $35.69 \pm 11.48$ ). Hence, null hypothesis is accepted (**Table- 2**).

The funnel chart (Fig-2) indicates that in Central North Indian region youngsters 107 (43.7%) are more prone to irritable bowel syndrome and as the age increases the number of IBS patients show a reduction [ $\chi^2(3, 245) = 56.176$ ;  $p < 0.001$ ]. As the probability value is less than 0.01 it indicates that the null hypothesis is rejected at 1% level of significance. Similar results were obtained in another community based Indian study<sup>7</sup>. Unhealthy food habits, high intake of caffeinated beverages, poor circadian rhythm, stress, alcohol consumption, sedentary lifestyle and hormonal imbalance were some of the causes reported by patients which made their IBS symptoms worse especially among young adults. Minimum numbers of patients were reported in old age i.e., above 50 years 26 (10.6%). A study done in Mississippi reported a similar trend with high number of patients below 50 years and less number above 50 years although the results were not statistically significant<sup>12</sup>. Another study from Norway reported that age less than 40 years decreased the risk of developing IBS as compared to older adults<sup>13</sup>. A Portuguese study reported that there is a higher likelihood of patients suffering from IBS-C if they are younger, solo and belong to low economic group<sup>13</sup>. A systematic review and meta-analysis also reported that the prevalence of IBS decreased with increasing age but none of these results showed statistical significance, one of the reason may be the use of different age bands which made it difficult to make generalized statement about the population<sup>14</sup>. In the same meta-analysis there were 14 studies which provided the data in terms of threshold of below and above 50 years where it was clearly reported that there was significant difference between the two groups thus proving high prevalence at younger age<sup>14</sup>. There can be several reasons for decreasing IBS prevalence such as improvement in diet and lifestyle with age, also older adults may develop a more stable gut micro-biota which is beneficial in reducing IBS symptoms. Among females after menopause there is a stability in hormonal levels which may have a positive effect on IBS symptoms thus reducing its prevalence<sup>9</sup>.

Figure-3 shows that maximum number of patients who visited the hospital were married (60.8%) followed by those who were single (36.7%) and only 2.4% were widow or widower [ $\chi^2(2, 245) = 126.47$ ,  $p < 0.001$ ]. Since the p value is less than 0.01, the null hypothesis is rejected at 1% level of significance. This shows that the observed value is not equal to the expected value.

Table-3 shows relation between gender and IBS-type, since the p value is more than 0.05, this indicates that there is no significant association between gender and types of irritable bowel syndrome based on stool pattern. Hence, the null hypothesis is accepted at 5% level of significance. It can be observed that maximum numbers of IBS patients were suffering from IBS-C (113) and minimum numbers of patients were suffering from IBS-U (34). However, a review from 25 studies inferred that IBS-C is more prevalent in developed countries and IBS-D is most common in developing countries, but the overall prevalence does not reveal any statistically significant difference ( $p = 0.32$ )<sup>1</sup>. Additionally, another 9 studies reported that the 4 sub-types of IBS were almost evenly distributed with 22.0%, 23.4%, 24.0% and 22.2% in IBS-C, IBS-D, IBS-M and IBS-U respectively<sup>14</sup>. Another systematic review comprising 23 studies reported that maximum numbers of patients were suffering from IBS-M (33.8%) and minimum from IBS-U (14.8%) using Rome III criteria. The same systematic review reported that there were only 2 studies which reported the prevalence of the sub-type of IBS using Rome IV criteria, wherein 31.5% patients suffered from IBS-D, followed by IBS-C (29.3%), IBS-M (26.4%) and IBS-U (11.9%) respectively. This indicates that based on the criteria used there can be differences in the prevalence of IBS. In addition to this even when same criteria were used, alterations have been reported in past studies in different countries due to variation in the method of data collection<sup>15</sup>.

Table-4 shows that there is no significant association between different age-groups and IBS-type [ $\chi^2(9, 245) = 3.848$ ;  $p = 0.921$ ] since, the p value is more than 0.05. Thus, the null hypothesis is accepted at 95% confidence interval. It can also be concluded from table 4 that IBS-C was the most common type of irritable bowel syndrome prevalent in all the age groups in Central North India affecting a total of 46.1% patients. Most of the people visiting the tertiary health care centre are either from lower or middle socioeconomic status, they usually lack fresh fruits and vegetables in their diet



which forms the major source of soluble and insoluble fiber. The major foods consumed by them on daily basis include-pulses, rice, roti, potato and bulbs like onion, and sometimes garlic. Some middle class and upper middle-class people add seasonal vegetables in their diet but they usually peel them and use frying as the cooking method thus completely dehydrating vegetables along with the removal of major part of fiber. Hence, we can infer that the diet consumed is low in fiber and almost negligible water content, thus, increasing the cases of constipation predominant IBS. Next to IBS-C, IBS-D was the most common type affecting 24.5% patients, followed by IBS-M (15.5) and IBS-U (13.5) respectively.

Table-5 shows association between relationship status and IBS-Type [ $\chi^2$  (6, 245) = 3.026; p = 0.806]. Since the p value is more than 0.05, we conclude that there is no significant association between relationship status and IBS-type; thus, the null hypothesis is accepted at 95% confidence interval. Similar results were obtained in another study conducted in Iran where being married or single didn't show any significant difference<sup>16</sup>. It was necessary to study the association between IBS and relationship status because the past studies have reported that IBS may affect the quality of relationships. A study from Portugal have reported that being single and belonging to low income group increases the probability of suffering from constipation<sup>17</sup>. A well-known fact is that, support and depth in a relationship play a key role in improving patients' health. Many studies have reported that IBS have affected partners love, consideration for them and it even affected their sex life<sup>18</sup>. Although IBS affects relationship but there was no significant association reported in different types of IBS (table-5).

Table-6 shows association between body-mass index and IBS-Type [ $\chi^2$  (12, 245) = 14.359; p = 0.278]. As the p value is more than 0.05, the null hypothesis is accepted at 5% level of significance. Majority (55.9%) of the IBS patients had normal BMI whereas only 14.7% were underweight and 29.3% were either Pre-obese or Obese. Similar findings were reported from another study conducted in Korea which reported that a higher BMI or higher subcutaneous adipose tissue was not associated with an increased risk of irritable bowel syndrome cases<sup>19</sup>. A review from University of Pennsylvania, United States suggested that there was a huge variation in obesity and cases of IBS which varies with the study population and there is need to conduct more studies to find the association between obesity and IBS<sup>20</sup>.

**Limitation:** Multicentric study done on larger sample size can give better results or study conducted on general population will provide a more precise prevalence of the disease, as in hospital-based study only those people who are aware about health usually report. The study was conducted in Uttar Pradesh so the results cannot be generalized to other places with different diet, culture and other environmental factors.

## Conclusion

The effect of sex, age group, relationship status and BMI was studied on IBS patients. The study was conducted in Gastroenterology OPD where 245 IBS patients were identified using Rome IV criteria. The mean age IBS patients were 34.25 years with higher number of males visiting the hospital. Majority of the individuals were married and no significant relationship was found between body mass index and sub-types of IBS.

The original research article highlights the importance of demographic factors and body mass index in the prevalence and management of IBS. The study was conducted in two major tertiary health care centres of Uttar Pradesh where patients from neighbouring states such as Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh etc. also come for treatment. The novelty of the research lies in the fact that this study specifically represents the data from central North Indian region which is typically underrepresented in global IBS research. The study concludes that in a hospital-based study in North India, majority of patients belong to IBS-C group who were young adults. The study also inferred that the IBS patients who visited the hospital were mostly married males with a normal BMI.

**Implication:** This study highlights the importance of individualized approach in the management of IBS. For example, people with IBS-C along with a high BMI must be given specifically formulated diet along with lifestyle changes for maximizing the benefits of treatment. The research also emphasizes the importance of targeted intervention in different demographic groups such as old females who have totally different requirements when compared with young male IBS patients.

**Suggestions for future:** This research work will be beneficial in guiding future studies and also in clinical management of IBS particularly with reference to demographic variables and anthropometric factors.

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